Metal Casting

BestPractices
Assessment Case Study

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AMCAST Industrial Corporation Energy Assessment

Summary

In 2000, a plant-wide energy assessment was performed at AMCAST Industrial Corporation's Wapakoneta, Ohio, manufacturing facility. The main objective of the study was to evaluate energy savings opportunities. The assessment was able to highlight process performance and its impact on overall energy and cost savings. The assessment resulted in recommendations for 12 separate projects that would improve the efficiency of the plant's production processes and decrease its energy consumption. These 12 projects have an aggregate annual energy savings potential of $3.7 million, which would lead to a 3-month payback. In addition, the implementation of these projects has the potential to reduce the plant's CO_2 emissions by over 11 million pounds per year. AMCAST is focusing on these opportunities and has begun implementing several projects identified in the assessment.

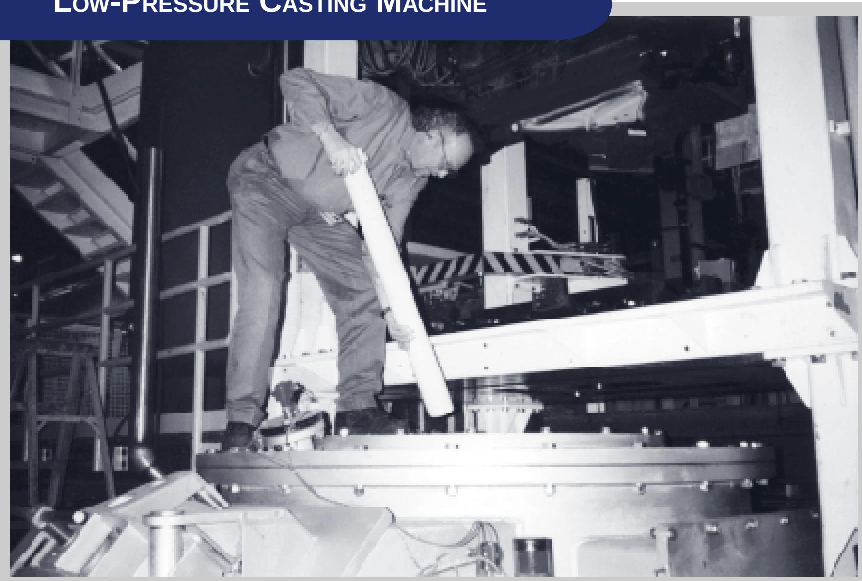
Benefits

- Provides a sound strategy for process improvement and energy efficiency
- Estimated annual cost savings of $3.7 million
- Estimated reduction in CO_2 of 11,000,000 lbs./year

Applications

In a metal casting plant, the production processes and other plant operations are energy intensive. Energy consumption in these types of facilities is primarily associated with the heat treatment of metals as well as the forging and casting processes that follow it. Periodic, system-level evaluations of a metal casting facility's industrial systems and production processes can reveal opportunities for significant improvements in process efficiency and energy savings.

Low-Pressure Casting Machine



Company Background

Founded in 1866, AMCAST is a major supplier of performance critical aluminum permanent-mold cast suspension components for the automotive industry. It also serves the construction industry and other industrial sectors. The Wapakoneta, Ohio, plant employs approximately 300 people and primarily produces low-pressure aluminum castings for automotive suspensions. The facility processes a total of 20 to 25 million pounds of aluminum annually.

Process Description

Since the primary products for the auto industry are aluminum permanent-mold castings, the plant performs heat treating and liquification of aluminum. Raw material comes in the form of aluminum ingots. Then, natural-gas-fired reverb furnaces melt the aluminum, which is transferred to hold furnaces adjacent to each low-pressure permanent mold machine via heated ladles. After casting, flash and scrap parts are sent back to a jet-melt furnace. Cast products are then solution and age-heat treated in special ovens, trimmed, inspected and shipped to customers or sent to other locations for additional processing. Primary waste streams include aluminum dross, recyclable aluminum flash, de-burring material, metal shavings, and cooling wastes.

Many industrial systems such as compressed air, steam, fans and pumps are required to support the plant's production process. In addition, the plant requires large quantities of electricity, natural gas, coal, and other purchased fuels to operate these systems as well as the furnaces it uses in its production processes.

Assessment Description

The Wapakoneta plant-wide energy assessment was partially sponsored by the U.S. Department of Energy's (DOE) Office of Industrial Technologies and was a joint effort between AMCAST, the University of Dayton, Ohio Department of Development, Office of Energy Efficiency, Miami Valley Diagnostics, Capital Surini Group International, Inc. (CSGI), and the Edison Materials Technology Center (EMTEC). As a result, the assessment represented a team effort to evaluate energy savings as well as waste and emissions reduction opportunities at the plant.

The manufacturing engineers and energy consultants that composed the project team monitored the facility's energy use, from the transformer and switches to production lines. Due to the team's in depth examination, it was able to make many recommendations that led to better energy efficiency and process improvements. Data drawn from the operations was downloaded to data loggers, where it was evaluated periodically utilizing state-of-the-art software technology and documented in a succinct, actionable, on-line format. The information reports included:

- Thirty-day snapshot of peak kW demand
- Daily peak kW demand (30 minute readings)
- Metered values by phase (current, voltage, and power factor)
- Circuit-loading summary
- Energy and power summaries
- Harmonic and disturbance analysis

The team also identified opportunities to improve the reliability of the plant's motor systems, as well as cases where equipment should be added or replaced. In some cases, the team offered solutions that eliminated the need to purchase equipment altogether. The team used energy data to calculate the expected savings and payback.

When analyzing the plant's existing motor systems, the initial focus was on identifying and minimizing end-use loads. Next, the distribution system was examined for inefficiencies and savings potential. Finally, after the end use and distribution systems were analyzed, the problem areas were examined for savings opportunities. In most cases, the end-use and distribution system savings directly influenced the recommendations for modifying the energy source. With this approach toward the plant's motor system analysis and production processes, the team was able to achieve the best possible results.

Energy Issues (Before Assessment)

Based on previous assessments of metal casting facilities and on the information provided by AMCAST, the following areas were deemed to have significant savings potential:

- Electrical systems: Three-shift operations offered the opportunity to move non-continuous operations with large electrical demand to off-peak periods.
- Lighting: Levels were recorded and compared to recommended lighting levels. Several possibilities materialized:
    1) Disconnecting obstructed lights or lights in overly lit areas
    2) Making better utilization of task lighting and sky-lights
    3) Replacing t12 lamps and magnetic ballasts with T8 lamps and electronic ballasts in the offices
- Motor drive systems: Motor repair and replacement policies were examined and the possibilities included:
    1) Use of premium efficiency motors
    2) Installing variable speed drives (VSDs) on the casting machines
    3) Replacing belts on motor drive systems with notched v-belts.

- Compressed Air System: The compressed air system was examined for savings potential from using outside air, reducing header pressure, reducing pressure loss in the distribution system, optimal staging of compressors, and effective use of cooling air and water.
- Process Heating: Several possibilities were explored:
    1) Optimizing combustion efficiency of the ovens and furnaces
    2) Using waste heat and pre-heat combustion or space-heating air
    3) Using solar walls to preheat process and space-heating air.

Assessment Recommendations

Once the data collection and analysis was complete, the assessment team came up with twelve separate recommendations for projects. In addition, the team validated and supported the implementation of a number of other initiatives that were being planned. The twelve recommendations that resulted from the plant assessment were:

1) Switching to aluminum-titanate riser tubes to replace the Dense Fused Silica (DFS) material. This initiative would result in reduced maintenance, less scrap, less downtime, and better product quality. It is estimated that savings in reduced scrap could exceed $1 million per year.
2) Using electric infrared heaters instead of existing gas torches to preheat permanent molds would further reduce scrap and save approximately $850,000 per year.
3) Improving tooling design, repair and tool maintenance could lead to annual savings of approximately $730,000.
4) Reducing scrap rate by addressing quality and scrap controls and increasing the number of quality control personnel to reduce rejects, could provide a projected net savings of approximately $470,000 per year.
5) Using exhaust heat from reverbatory melting furnaces in heat treating furnaces. This will result in annual natural gas savings of $157,000.
6) Using exhaust heat from heat treating furnaces in aging ovens. This will result in additional estimated annual savings of $93,000.
7) Implementing other energy savings opportunities for reverbatory furnaces (capturing flue gas losses, radiation losses, furnace wall losses and eliminating air leakage from furnace openings). It is projected that these measures will save $64,000 per year.
8) Relocating jet melt furnaces and improve the jet melt process flow by moving the furnaces closer to the jet melt-recycling unit. This will result in savings in energy, labor and maintenance that are projected to total $89,000 annually.
9) Installing VSDs on casting machines. The estimated annual energy savings from this measure are approximately $37,000.
10) Using blowers to pressurize die cast hold furnaces. This will result in estimated annual savings of $11,000.
11) Using plant cooling tower water to cool the compressed air system instead of city water. This will save $10,000 per year in reduced municipal water fees.

12) Using exhaust heat from heat treating furnaces for scrap pre-heating. This simple measure will recapture some heat and save an additional $3300 per year.

Pollution Control

In addition to energy waste minimization, the study examined opportunities for emissions reductions. After analyzing the performances of the motor systems and the production processes, the team realized that minimizing the plant's motor systems' energy usage would reduce the amount of pollutants that the plant caused. The team reviewed the reductions in energy consumption that would result from the implementation of the 12 projects and determined that these improvements could result in annual CO_2 reductions of 11,000,000 pounds.

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Expected Results

The energy assessment conducted at the Wapakoneta plant involved the review of all major plant systems such as furnaces, boilers, electrical equipment, compressed air, fans and pumps. Together with the scrap reduction efforts, the twelve projects that the study recommended would lead to annual energy savings of over $3.5 million. Additional miscellaneous reductions in utility costs could provide $200,000 of further savings, bringing the total to $3.7 million per year. Since the total project costs are estimated at approximately $1 million, the simple payback would be just over 3 months.

Just as important as the specific conservation measures and their associated savings, the approach to the assessment was generic enough that it can easily be applied to other aluminum casting facilities. In fact, AMCAST plans to replicate many of the recommendations from the Wapakoneta plant study to its other metal casting plants.

Industry of the Future—Metal Casting

The metal casting industry – represented by the American Foundrymen's Society (AFS), North American Die Casting Association (NADCA), and the Steel Founder's Society of America (SFSA), has prepared a document, ***"Beyond 2000,"*** *to define the industry's vision for the year 2020. OIT's Metal Casting Vision Team partners with metal casters, national laboratories, universities, and trade/environmental/technical organizations to develop and implement energy efficiency technologies that benefit both the industry and the United States. Recently, the Metal Casting Team facilitated the development of the Metalcasting Technology Roadmap, which outlines industry's near-, mid-, and long-term R&D goals.*

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BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

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